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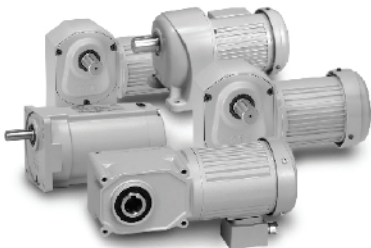


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JUNE 2022



A Publication of
The American Gear
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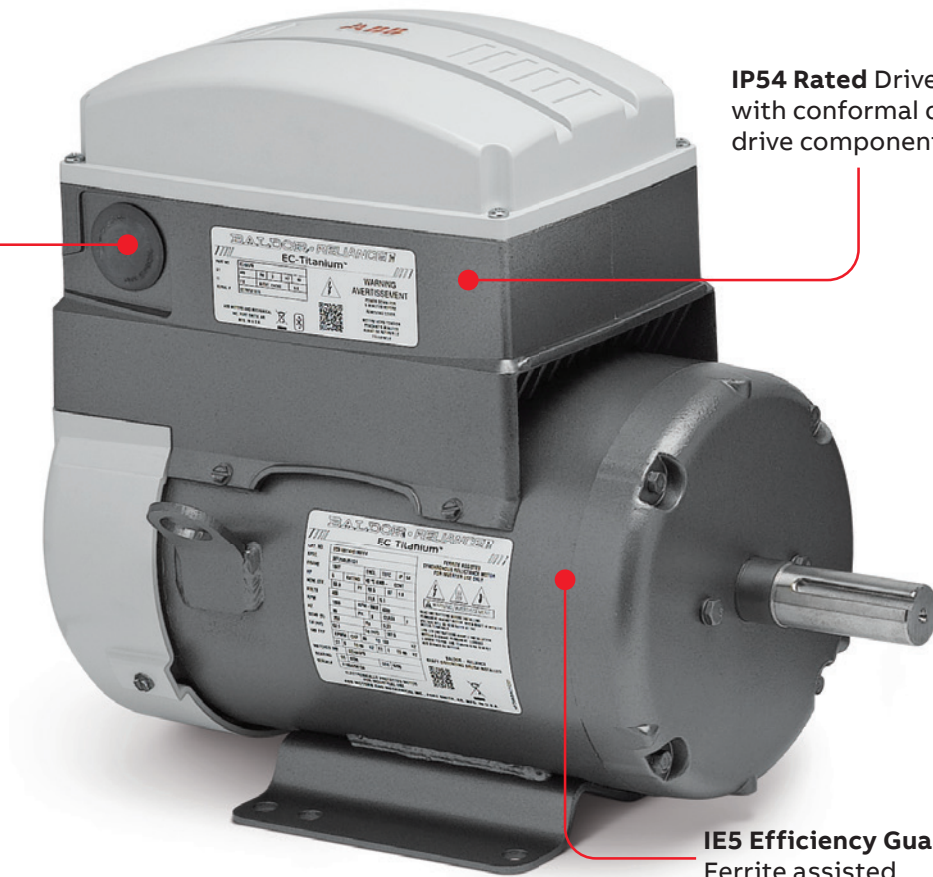
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PTE Videos

Mayr Offers Intelligent Brake Monitoring

The Mayr ROBA-brake-checker continuously checks the safety brakes in your system: The switching module warns in case of abnormalities and even before a defect occurs.

powertransmission.com/media/videos/play/218



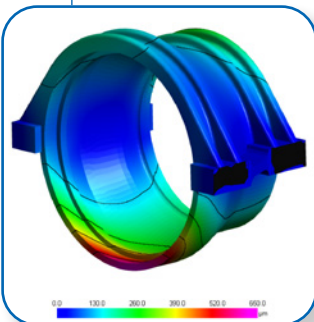
Wichita Clutch Conveyor Brake

Wichita Clutch provides a modular conveyor brake for a cement plant application.

powertransmission.com/media/videos/play/220

PTE Revolutions

MESYS AG Offers Latest Software Updates for Bearings and Shafts



The following article includes some of the new features and capabilities available for MESYS Rolling Bearing Calculation and MESYS Shaft Calculation:

powertransmission.com/blogs/1-revolutions/post/8583-mesys-offers-latest-software-updates-for-bearings-and-shafts

Performance and Safety Top Priorities in Gear and Gear Drive Applications

The gear and gear drive segment of mechanical power transmission continues to focus on performance, reliability and safety. There are several new products offering increased load capacity, reduced friction and longer service life.

powertransmission.com/blogs/1-revolutions/post/8572-performance-and-safety-top-priorities-in-gear-and-gear-drive-applications



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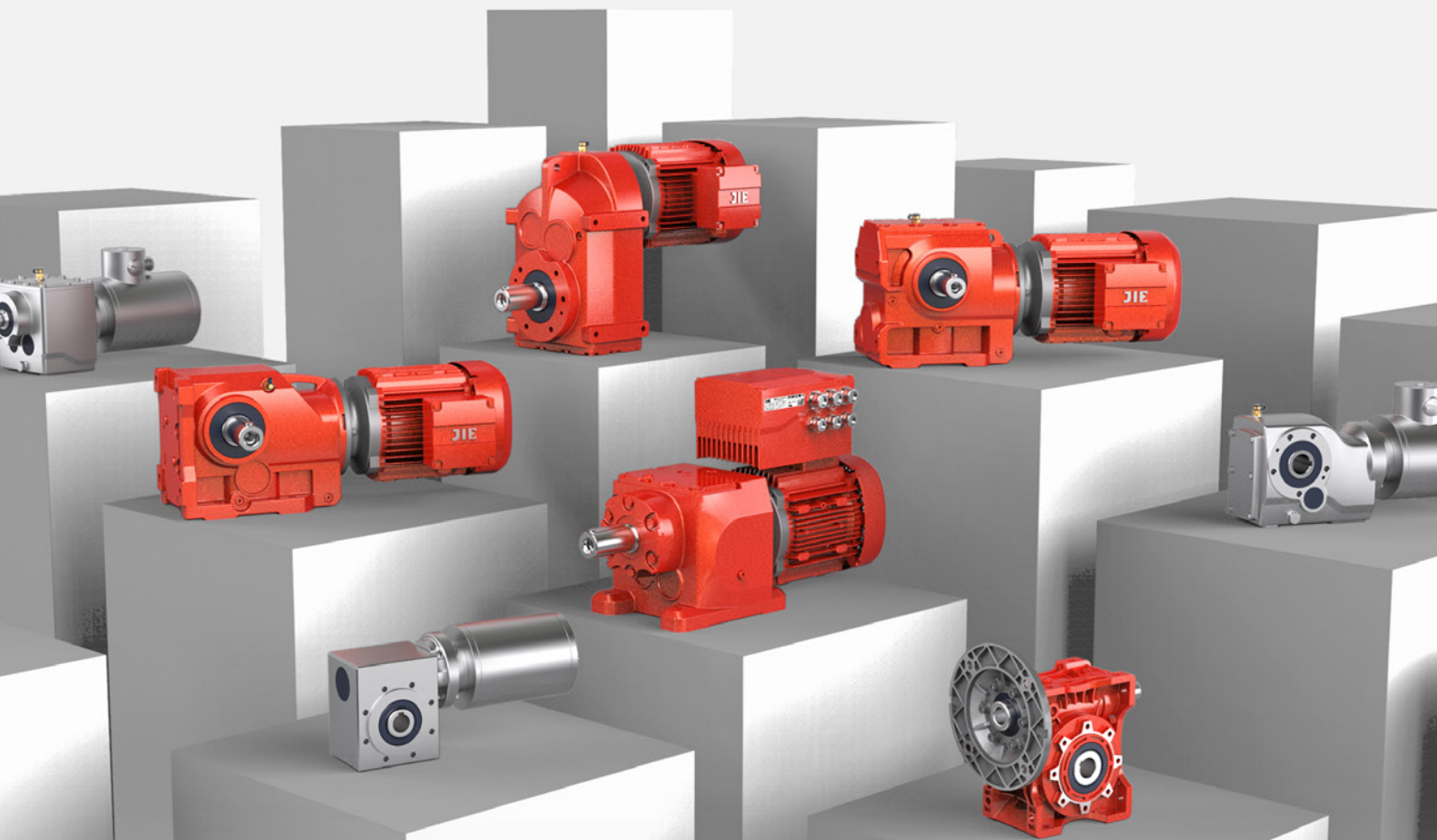
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Michael Goldstein founded Gear Technology in 1984 and Power Transmission Engineering in 2007, and he served as Publisher and Editor-in-Chief from 1984 through 2019. Michael continues working with both magazines in a consulting role and can be reached via e-mail at michael@geartechnology.com.



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Don't Miss Out



We have a lot of great content planned for you over the coming months:

- August 2022: Focus on Heavy Industry, with articles covering the use of power transmission components in industries like primary metals; aggregate, cement and asphalt; pulp and paper; and chemicals. We'll talk specifically about components like mill drives, couplings, belt drives and chain drives.
- September 2022: Focus on Factory Automation, with articles covering Hannover Messe USA and IMTS, along with industries such as medical, robotics and precision motion. We'll write about components like gears, electric drives, gearmotors, servo drives and more. And we'll touch on topics like additive manufacturing, IIoT and smart manufacturing.
- October 2022: Dual Focus—Aerospace and Defense, along with Packaging. On the aerospace side, you'll see coverage of applications like helicopters, airplanes, drones and spacecraft. For packaging, we're highlighting Pack Expo, but we're also covering material handling, food and beverage and more.
- December 2022: Focus on Motion Control, with articles covering a wide variety of industries using components like linear motion, servo drives, controls, sensors, conveyors and more.

And that's just the printed magazine. Between now and the end of the year, our e-mail newsletter will hit on topics like belt drives, linear motion, gearmotors, couplings, pumps, mechatronics, bearings, e-mobility, gear drives, software, condition monitoring, fluid power, lubrication, seals and much, much more. The e-mail newsletter comes out four times a month and it almost always includes online exclusive articles.

Both the printed magazine and the e-mail newsletter also always include coverage of our core subjects: bearings, gears, gear drives and motors. So you can count on us to keep the information flowing on the components that put the power in power transmission.

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3. It allows us to demonstrate to our advertisers that we continue to reach the best possible audience of people interested in power transmission and motion control.

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P.S. We're also always on the lookout for new contributors.

If your company is doing something interesting related to one of the topics mentioned above—or if you're interested in writing about one of them—there's still time to get included in our editorial coverage. The best way is to contact Senior Editor Matt Jaster via e-mail at jaster@agma.org.



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Warner Electric

DEVELOPS MATERIAL SOLUTION FOR BRAKES

While cold rooms are essential for storing products in the food and beverage industry, the very conditions that allow preservation present a very real challenge to power transmission equipment. As any motorist will know, brakes can be particularly susceptible to performance drop-off in cold or moist conditions. To ensure that forklift truck brakes can operate reliably in cold room environments, Warner Electric has developed custom brake friction material that provides consistent performance despite extreme temperature variance and the effects of moisture.

Positioned in line with the motor or between the motor and the gearbox, spring applied electromagnetic motor brakes are utilized on forklift trucks to provide service and parking braking. OEMs typically require specialized braking systems for forklifts operating in the food and beverage industry, due to the multiple application challenges of operating in cold rooms.

Brakes must provide consistent performance in all conditions. However, moving in and out of cold rooms into different environments around the facility demands consistent brake performance across a wide temperature range. To present a further challenge, this variance in temperatures can cause condensation to build up on brakes, which can lead to another phenomenon: sticking.

Sticking happens when moisture causes standard friction materials to bond with the counter-friction surface when the forklift is parked. Consequently, the brake and motor are locked in place, stopping the truck, and causing downtime while maintenance is arranged.

With tight, contract delivery schedules for supermarkets, suppliers and other vendors to be met, having a forklift truck out of action for any period is undesirable in the food and beverage industry. To help improve uptime



for end users, Warner Electric, a global manufacturer of electromagnetic braking solutions for forklift trucks, addressed these multiple environmental challenges with a new material solution.

Warner Electric has developed proprietary friction material specifically designed for cold room and outdoor environments with high moisture levels and wide temperature differentials. Developed and tested in-house, the new material retains stable torque characteristics for static parking and high energy stopping in tough cold and wet environments. Furthermore, it is specialized to combat the sticking phenomenon.

To prove the performance of the new material, rigorous testing was carried out. A climate chamber was used to simulate the extreme temperature changes of moving in and out of the

cold room. The results were then compared with cold environment tests in the field, ensuring the material would perform in the real-world. Engineers also conducted endurance testing. Both the lab and field test results confirmed that there was virtually no sticking — not even a tenth of a Nm of drag torque.

The new material is currently available on all Warner Electric PK motor brakes in different configurations depending on customer requirement. A popular selection for forklift trucks, power dense PK brakes are available with an enclosed design, ideal for applications where the brake may be exposed to moisture.

warnerelectric.com

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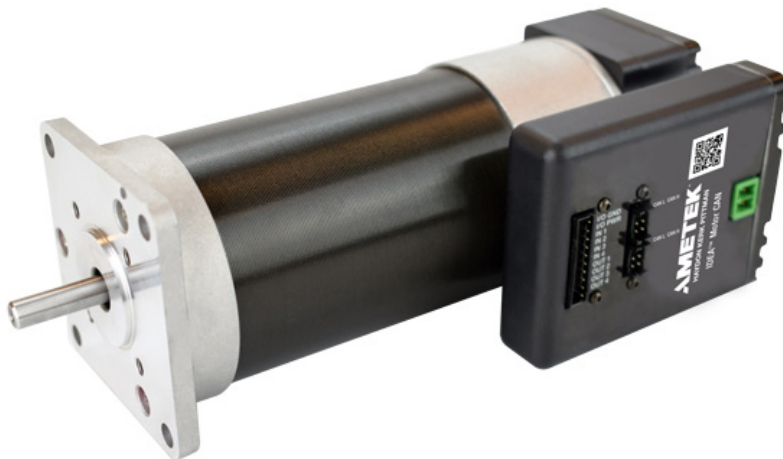


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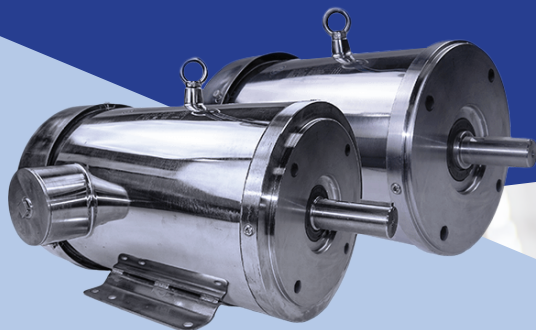
EXPANDS IDEA MOTOR SERIES

Ametek Haydon Kerk Pittman (HKP), a business unit of Ametek, has announced a new size in its IDEA Motor series of brushless DC motors: 57 mm. This EC057B joins the 42 mm EC042B product introduced in 2019 and enhances an already popular line of motors with integrated, programmable drives.

The IDEA Motor combines a



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precision brushless servo motor with an IDEA Drive controller to reduce design time, wiring needs, and overall cabinet space, which in turn leads to lower system costs. The programmable drive is specifically designed for real-time, embedded motion control and is well-suited for autonomous and precise single-axis motion.

Benefits of designing with the IDEA Motor series include:

- *Saving components, money, and space:* An integrated package replaces the more traditional and more complex brushless DC motor + external drive + encoder + cables setup. A single motor/drive unit reduces components by up to 75 percent per axis and simplifies troubleshooting. Further reductions can be achieved by wiring sensor inputs and control outputs directly to the IDEA Motor rather than through a control cabinet.
- *Saving time:* The pre-engineered, factory-configured and -tested servo system with intuitive programming capability allows customers to immediately develop, save, and debug complex and precise motion sequences. Simply add power, optional I/O connections, and communications, and the IDEA Motor is ready to operate.
- *Reducing design complexity:* RS-485 or CANopen communications fieldbus ports are integrated for programming autonomous motion sequences, monitoring system status, or streaming commands to synchronize motion among multiple motors.

Each of the motors in the IDEA series is available with optional factory-configurable gearboxes. The wide range of reduction ratios and torque capabilities enables optimized performance for unique motion applications that demand precision in tight



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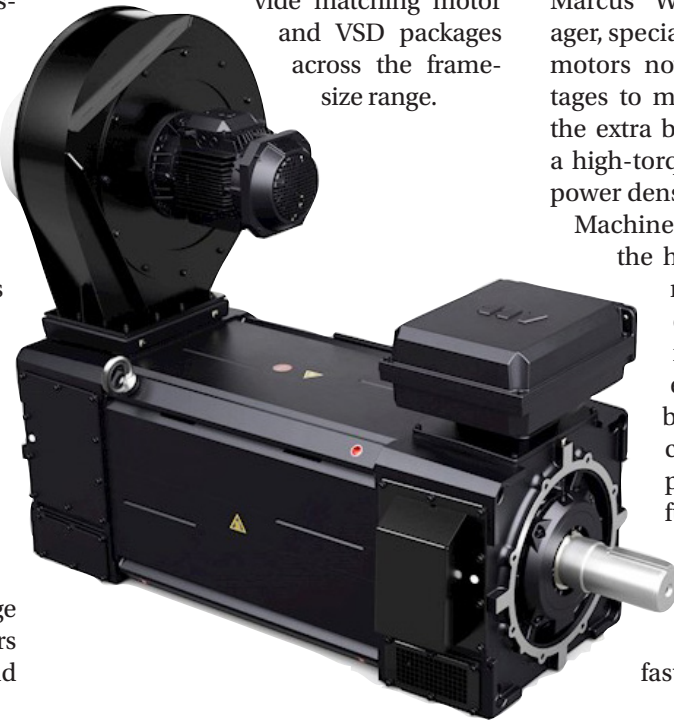
UPGRADES HDP MOTORS

ABB has upgraded its extensive range of high dynamic performance (HDP) induction motors. This creates new opportunities for machine-building OEMs seeking motor and drive solutions with dynamic response and high-power density. The motors are typically used in plastic and rubber extrusion, injection molding, winders, lifting, conveyors, test benches and machine tools.

The upgraded HDP motor range enables ABB to offer machine builders frame sizes between 80 and 400, and

output capacities up to 2 megawatts (MW)—as well as alternative variants such as high-speed and water-cooled motors. The motors are designed for use

with a VSD, and ABB can provide matching motor and VSD packages across the frame-size range.



“ABB is well known for its optimized motor and VSD packages that provide precise motor control and maneuvering capabilities in a wide variety of general industrial applications,” said Marcus Westerlund, product manager, special/motors at ABB. “The HDP motors now bring the same advantages to machine builders who need the extra boost in power provided by a high-torque design and exceptional power density.”

Machine builders can capitalize on the high-power density of HDP motors in two ways. They can retrofit an existing machine with a more powerful replacement motor to boost performance; or they could select a more compact, yet equally powerful motor when designing a new machine to reduce its footprint.

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maneuvering precision due to their low inertia and high overload capacity. Low-inertia motors are ideal for applications requiring fast changes in rotational direction to enable, for example, faster back-and-forth machine motion.

ABB has prioritized ease of installation as an integral element of the HDP design. That makes it easy to install a replacement HDP motor into an

existing machine without excessive engineering work. Furthermore, ABB has considered simplicity in everything from accessible connection points to installation of accessories, such as cooling fans, encoders and brakes, whether from ABB or a third party.

The upgraded HDP motor range includes all the commonly requested

frame sizes and technology variants such as water-cooled, high-speed and MW-class alternatives to allow ABB to meet most machine-building requirements without extended delivery times. Should the standard design not meet a machine builder's specific needs then it can be customized.

abb.com

BCA Bearings

EXPANDS AFTERMARKET PRODUCT LINE

NTN, the parent company of BCA Bearings, has announced the addition of 16 new product SKUs to the BCA aftermarket product line. BCA's March 2022 release includes wheel hub assemblies and repair kits for a number of import and domestic applications and represents premium coverage for over 6.9 million vehicles in operation. This is BCA's final release for the 2021 fiscal year ending March 31, 2022.

"This final release of our 2021 fiscal year serves to keep the BCA product

line aligned with the demand we see in the aftermarket," said Rina Dafnis, assistant product manager automotive aftermarket. "We base our product line additions on multiple data points, and a majority of these new applications are just now coming into the aftermarket sweet-spot where we begin to see the vehicle age and mileage that necessitates the replacement of the original equipment wheel hubs."

These new SKUs supplement BCA's coverage for Asian brands, including Hyundai, Kia, Nissan, Infinity, Toyota,

Lexus, and Mazda. Also of note, is added coverage for Mercedes-Benz GLS-Class SUVs, which recently began production with the 2020 model year. Finally, this release provides additional coverage for multiple Ford Motor Company brands, including the first-generation Ford Fusion platform, the third-generation mid-cycle refresh of the Expedition/Navigator, and the first generation of Ford's high-performance F-150 SVT Raptor.

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Mayr Power Transmission

INTRODUCES ELECTROMAGNETIC SAFETY BRAKES FOR LINEAR MOVEMENTS

The new electromagnetic linear brake ROBA-linearstop from Mayr Power Transmission offers a fail-safe system with high holding forces, which can also brake dynamically and provide short switching times.

Safety brakes, which influence separate round rods or piston rods or on guide rails, are often used to safeguard linear movements. Depending on the application, pneumatically or hydraulically opening brakes, that reach high holding forces, are often used for this purpose. But drive axles are nowadays increasingly equipped with electric motors. Purely electrical systems — also for safeguarding — are the trend.

If the drive fails completely during these operating conditions, the linear brake alone is responsible for the reliable deceleration of the load. Which is why the safety brakes are also designed for such dynamic braking situations. The company has voluntarily subjected the brakes to a type of examination as a safety component in accordance with the Machinery Directive (2006/42/EC).

On vertical axes, short stopping distances are important for the safety of people and machines. The brake switch-



ing times are decisive for the braking distance, as during the free-fall time until the brake closes and the retardation takes effect, the mass additionally accelerates. The new electromagnetic linear brakes therefore impress with their short switching times.

“In comparison to previously common products, our brakes switch faster by a factor of 10,” added Kees. However, maximum safety is only achieved if the projected switching times are guaranteed over the entire service lifetime. Therefore, reliable switching condition monitoring is key. In the new electromagnetic ROBA-linearstop brakes, the control module is used for this purpose. For larger brakes (from construction size 40), monitoring with proximity switch is also possible.

In addition to linear brakes for piston rods, Mayr Power Transmission is currently working on electric safety brakes for profiled rails.

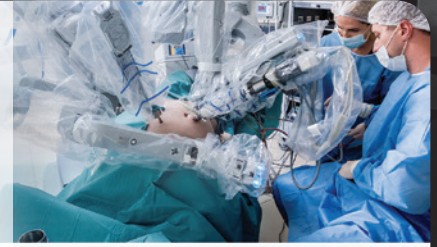
mayr.com

“We offer electrically opening linear brakes which are also safety brakes,” said Bernd Kees, product manager at Mayr Power Transmission. This means, the brakes operate according to the fail-safe principle. They generate the braking force through thrust springs and are closed in de-energized condition. The new series of electromagnetic ROBA-linearstop brakes comprises six construction sizes with forces ranging from 70 to 17,000 N.

“Most linear brakes available on the market today serve as static clamping units and have been designed to hold the axes safely at a standstill,” said Kees. “However, there might be people under suspended loads during initial operation, maintenance or even during the production process without the load transfer to the mechanical linear brake having taken place first.”

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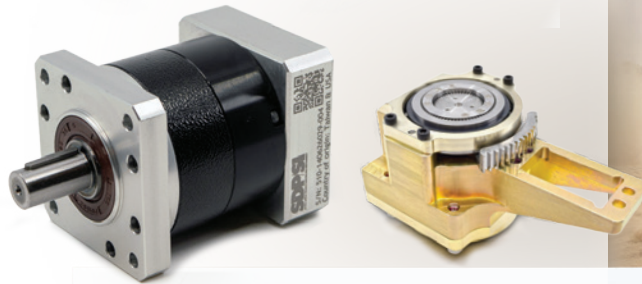
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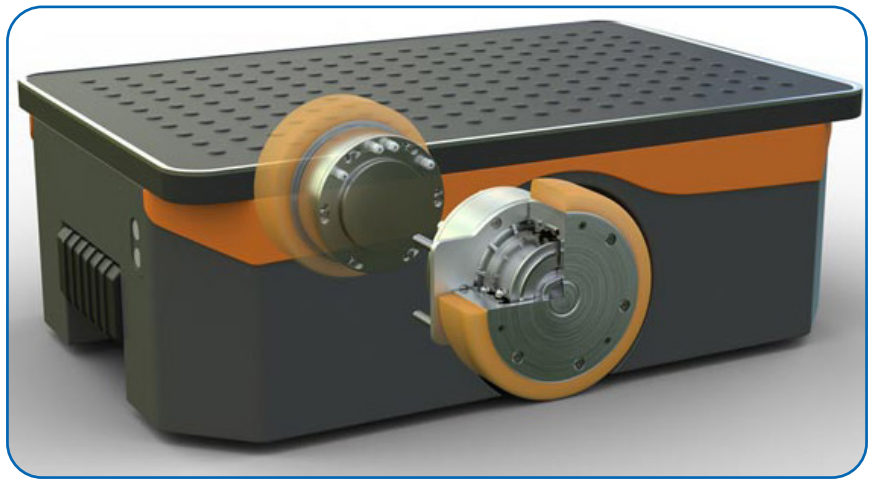


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Framo Morat and Heinzmann

COLLABORATE ON WHEEL HUB MOTOR

The drive system manufacturer Heinzmann has introduced a new wheel hub motor with integrated transmission, which was developed in close collaboration with Framo Morat. The compact, high-performance drive provides efficient operation in automated



guided vehicles (AGV) and autonomous mobile robots (AMR).

Since all components of the drive—from the motor and transmission to the output shaft along with the bearing—have been integrated in one housing as a unit, the solution is extremely compact and robust. It has an axial length of just 110 mm at a wheel diameter of 160 or 200 mm, which provides a space-saving and self-cooled drive unit weighing only 7.5 kg. Even during rough operation, each wheel can handle up to 500 kg (5000 N). The compact drive system is equipped with one- or two-stage transmissions and, at a gear ratio of 1:32, delivers a maximum drive torque of up to 120 Nm. The robust design of the motor and transmission guarantees a service life of 20,000 hours. Thanks to the IP67 protection class, the drive system is suitable for all areas of intralogistics and robotics.

A two-channel motor controller that is perfectly matched to the system controls up to two drive wheels. The steering function is enabled by the different speeds of the two drive wheels. Electrical differential, torque vectoring and recuperation are standard with this system. Customer-specific programming of the controller is possible, as is customized equipment of the drive, for example, with an additional mechanical parking or service brake, a high-resolution encoder and much more.

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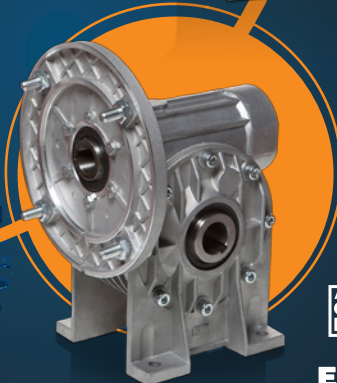
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Kollmorgen

ANNOUNCES TBM2G MOTOR SERIES

Kollmorgen has announced the new TBM2G series of frameless servomotors, introducing features that simplify the design of collaborative, surgical, aerospace and defense and other robots while delivering optimal performance in a lighter, more compact package. These new motors will complement Kollmorgen's existing TBM and KBM series of frameless motors.

Resulting from several years of research, testing and customer feedback, the TBM2G series offers high-performance torque in an extremely compact electromagnetics package. These next-generation motors enable robots with lower joint weight, higher load-carrying capacity, improved energy efficiency, lower thermal rise, and faster, smoother movements.

Frameless torque motors typically deliver their best performance at low speeds but suffer at higher speeds. TBM2G motors remove this limitation through advanced windings and materials that deliver industry-leading power, torque and efficiency consistently across a wide speed range.

TBM2G motors also remove the sizing limitation that engineers often face when using off-the-shelf strain wave gearing, also known in the robotics market as harmonic gearing. The new TBM2G series motors are sized for a perfect fit with readily available strain wave systems, eliminating the need for extensive customizations that can increase engineering time and cost while potentially leading to supply and quality issues when robots enter full production.

The TBM2G series is available in seven frame sizes with three stack lengths each—a total of 21 standard motors that can be integrated directly into robotic joints and similar embedded equipment.

kollmorgen.com/TBM2G



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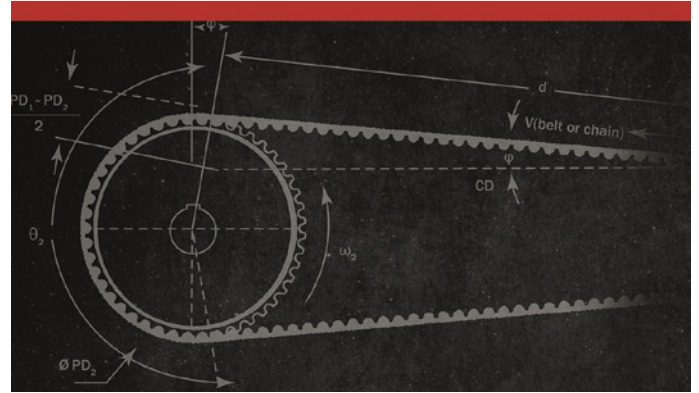
Gates

LAUNCHES BELT DRIVE SOFTWARE PLATFORM

Gates has announced the launch of *Gates Design Power*, a new software platform offering multiple digital design tools to support the engineering and specification of belt-drive systems across a broad array of applications, making the process easier and more robust than ever before.

“At Gates we are committed to relentless innovation and finding ways to make our customers’ lives easier. Digital innovation is as important as product innovation in making this happen,” said Tom Pitstick, chief marketing officer and senior vice president of strategic planning for Gates. “The new *Gates Design Power* software platform builds upon our existing design tools to support our Global ‘Chain to Belt’ initiative, making it even easier for engineers across all applications, from two-wheelers to manufacturing equipment, to design-in our products and get the most out of their belt drives.”

This new digital toolkit consists of six modules, including four all-new applications and substantially upgraded versions of well-known Gates digital tools, *Design IQ* and *Design Flex Pro*. Among the all-new programs is the industry-first Mobility Drive Analysis tool aimed at making it easier for engineers from bicycle, scooter, motorcycle, and power sports OEMs to design Gates clean, quiet, durable and low-maintenance Carbon Drive belt systems into their



next-generation vehicles, further accelerating conversion from chain and other technologies.

Gates Design Power is now available globally as a free download and includes 15 different languages for use across most regions. Development of the *Design Power* platform is ongoing, and additional features and enhancements are planned to roll out over the next 12 months, including mobile device compatibility.

gates.com/us/en

SMT

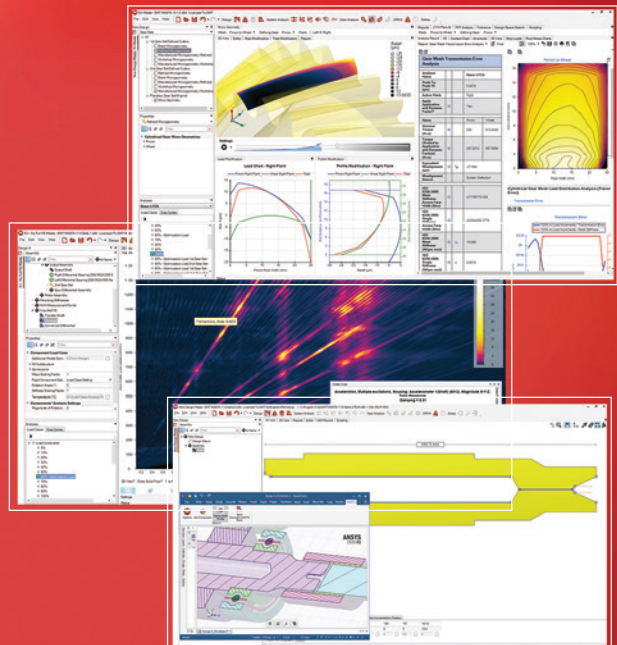
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How Will We Fuel the Future?

CTI Symposium 2022 addresses our path toward electrification

Matthew Jaster, Senior Editor

My first trip to the CTI Symposium USA six years ago was eye-opening regarding the ambitious forecasts for electrification in the automotive industry. Hybrid transmissions took center stage back then with a hint at a fully electric future on the horizon. Individual components were showcased in the expo hall as well as the technology sessions. Optimism for self-driving vehicles, e-mobility and the switch from ICE to electric vehicles was somewhat restrained.

Today, the future of EV and HEV drives and components looks much more attainable. Individual components are now being replaced by systems being coordinated by software in

a new digital microcosm. GM is committed to an all-electric future. So is Ford, Stellantis, Volkswagen, Toyota and any other automotive company that wishes to remain relevant in 20 years. The latest CTI Symposium confirmed this electric journey.

According to Dr. Hamid Vahabzadeh, chairman, CTI Symposium USA and strategy advisor, AVL GmbH, the CTI Advisory Board has been focusing on the leading-edge technologies and providing a forum for the industry to debate and discuss the latest technologies needed for the next generation of vehicles.

CTI started about 20 years ago as a transmission and driveline technology symposium. Initially, the focus was on

conventional automatics and manual transmissions. Over the years, this coverage expanded to DCTs, CVTs, and a wide variety of advanced and novel transmission concepts. Most recently, as the industry began the pivot to electrification, he said the industry shifted focus to hybrids and covered a wide range of hybrid concepts including modular (add-on) hybrids as well as dedicated hybrids.

“Now we see a clear transition to Battery Electric Vehicles (BEV) for light duty and passenger car applications and potentially fuel cell technologies for medium and heavy-duty applications. Therefore, our ambition is to stay on top of the trends, and focus our content, papers, speakers to capture the industry



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electrification

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challenges in this area and invite speakers that are working on advanced BEV systems and sub-system technologies including; new batteries, e-motors, e-axles, power electronics and grid integration. Facilitating the debates via panel discussions to prep the engineering community on how quickly changes are coming,” Vahabzadeh said.

An Electric Mindset

The EV market has been growing steadily over the last few years. The legislation and scale of EV is real now. This was not always the case.

“Five to 10 years ago, the feeling wasn’t as certain, but now it is inevitable. The unknown is how quickly supply chains can be enabled to support

the full pivot to BEV. Many OEMs have announced their plans to convert their products to pure electric drives. The timing may not be as fast as everyone states. It may take a bit longer to make it a reality based on the need to mine the critical materials and then put the capital in the ground to process the minerals that are needed for all these batteries,” Vahabzadeh said.

The automotive industry has faced several challenges and very tough regulations in the past. They have shown to be very resilient and creative in meeting new regulations by developing and implementing new technologies, managing their fleet mix, and purchasing or trading credits with other OEMs, and occasionally, paying

penalties. The 2030 regulatory targets are not any different. While they are very challenging, Vahabzadeh said will be met one way or another.

When it comes to BEVs, Vahabzadeh said consumers are mainly concerned about their total ownership cost and practicality of their selection. There has been a significant effort and development aimed at improving the energy density and cost of batteries resulting in a noticeable reduction in the total cost of the battery packs, and consequently, the electric vehicle prices. “This has also improved the operating range for the BEV which is another major concern for the average consumer. However, these improvements are not sufficient and need to



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continue on the same path to make the BEV affordability a reality for the average consumer. Another big factor is the infrastructure and availability of fast charging stations to ease the range anxiety that some consumers may have."

There's enough information out there regarding our global path toward electrification that consumers are a lot more educated and smarter these days. Vahabzadeh said that the green aspect of these vehicle has played a major role in considering an electric vehicle.

"They are fantastic to drive. As consumers get into them, they will love them. They like the vehicle performance and smoothness. The ride and handling of BEVs are impressive. This

and is always addressing the most relevant questions, delivering viable solutions and proposals for future mobility options. The intensive cooperation with the advisory boards in each region provides the latest information for the entire automotive community.

The programs are a mixture of topics which are relevant for each region and meeting regional specific questions. The markets and regulations are not developing 100 percent parallel in terms of surrounding conditions, political framework and customer choice. The CTI events share viewpoints, findings and strategies and address local questions. For example, BEV systems are currently the focus here in the United States whereas CTI

This year's U.S. Symposium offered new concepts and technologies being developed by different companies to enhance the current state-of-the-art of the BEV. Executives in charge of the leading OEMs and suppliers discussed their strategies for meeting the consumer expectations in cost, quality and performance while trying to meet strict regulations. Vahabzadeh enjoyed hearing how the different companies feel about the pivot to BEV. Will it happen as quickly as their stated goals or will we continue to see an overlap of traditional drivetrains, hybrids, and BEVs for a protracted period of time?

Questions Moving Forward

The future of EV markets in each region are mainly driven by the legislations, government incentives, and regulations. China and Europe are leading in implementing BEVs with US market following. While the China market is converting to BEV, it is also entertaining the plug-in hybrid option.

Vahabzadeh does not foresee a significant change of topics in the near future. Electrification will continue to be the focus for upcoming programs.

"As more and more BEVs enter the market, sufficient electric power generation and efficient distribution infrastructure will be more prevalent. New battery technologies and more efficient e-motor technologies will be discussed," Vahabzadeh said. "Vehicle affordability for the average consumer and new business models and purchasing/leasing options will be discussed. Continued supply chain constraints, and raw materials availability will be of concern. How will OEMs evolve and vertically integrate with BEVs? Will they continue to outsource areas, or bring those in house and consider them core to their experience?" **PTE**

drivetrain-symposium.world/us/



is due to their low center of gravity and people have noticed this and like it very much. But I am not sure everyone loves the price today," he added.

The Evolution of CTI Symposium

CTI Symposium has been taking place for two decades. What started as a transmission conference, turned into a hybrid drivetrain forum, and has transformed into an electric drivetrain conference. It's an opportunity for attendees to recognize trends and strategy changes early, paying close attention to technological developments and regulatory influences. Thus, CTI was

Symposium-Germany is looking at fuel cell electric vehicles (FCEVs).

"With our events we want to connect the biggest automotive markets and regions where the engineering work happens. Regions and markets have their commonalities but also differences in terms of regulations, government incentives, political surrounding conditions, customer expectations, vehicle usage, etc. To support the exchange of opinions, viewpoints, strategies and engineering developments, CTI has created a 'World Series' bringing companies and experts from all over the world together within each region," Vahabzadeh said.

Topics at CTI Symposium USA

Here's a small sample of the technologies discussed during the CTI Symposium 2022 in Novi, Mich.

Thermal Management for EVs

Energy is a precious commodity in electric vehicles. Using sophisticated thermal management, designers can extend vehicle range at a stroke by reducing the power needed for optimal temp control of interiors and batteries. High-performance thermal management is also a must for fast charging – and the performance, operational reliability and service life of various system components all depend on a functional thermal management setup. At CTI, topics in the field of thermal management included thermal analysis tools for EDUs, a central coolant control module, and highly effective immersive cooling.

When checking EDU subsystems and components for smooth operation or dangerous hot spots, today's designers have various tools at their disposal. But as Michael Furness, Drive System Design, USA, explained, "With this kind of silo-based design approach, you risk overlooking crucial thermal interactions at the system level."

The Thermal Analysis Tool developed at Drive System Design accesses existing subsystem datasets to quickly generate a system-level thermal model of the design. The tool has been automated to ensure fast modeling. It can be used cost-effectively at every stage of the EDU development cycle and can help to inform design decisions on every level.

By running a system-level thermal analysis early on, designers can reduce the likelihood of costly changes further downstream. The short simulation cycle significantly reduces development time and supports designers without the need to parameterize and apply costly FEA programs. Thanks to the tool's modular implementation of heat transfer physics, designers can use simple empirical equations at an early design phase to obtain a rough understanding quickly. When more mature analyses become available, they can be fed into the tool to improve accuracy.

drivesystemdesign.us

Small Electric Motor Improvements

As all designers of electric motors know, seemingly small improvements can yield tangible benefits. In his presentation, DeeDee Smith (Solvay Materials, USA) discussed optimizing the insulation materials used in electric motors.

Specifically, the issue concerns the slot liners that shield the stator core from the winding. As OEMs progressively migrate from 400-volt systems to 800 volts or higher, it's becoming clear that traditional paper/paper laminate insulation is no longer ideal. To address that issue, Solvay has been working with e-motor designers to evaluate the suitability of Ajedium PEEK slot liners as a new

high-voltage, high-temperature solution. As their findings show, Ajedium PEEK slot liners are an advanced alternative that combines excellent electrical and mechanical performance with greatly reduced thickness. In some cases, volumes can be reduced by up to one third, compared to established solutions.

Engineers can exploit this advantage to increase the motor's power density, either by making the e-motor more compact or by using the free space in a way that enhances performance. The thermoplastic PEEK film is temp-resistant to 240°C and offers improved thermal conductivity—more than three times that of current paper and paper laminate materials. This in turn helps to reduce overall motor temperature.

solvay.com/en/usa

High-Speed Traction Motor Production

How do you produce rotor and stator cores for traction motors at high speeds and volumes, at low costs and in perfect quality? In his presentation, Max Thieme (Schuler Pressen, Germany) examined the optimal solution for this challenging task.

First, the speaker presented and compare the basic methods for stamping sheet metal for electric motors. He focused on ultra-modern bonding techniques such as interlocking, gluing and bonding varnish/Backlack, all of which can be used to combine metal sheets into a complete package. Bonding varnish in particular offers convincing benefits. Unlike interlocking and welding, this process rules out short circuits between individual sheets. As a full-area bonding method, it also outperforms gluing – no liquid can penetrate, and thermal conductivity and NVH behavior are both better.

Finally, Thieme explained why progressive dies are suitable to produce traction motor stacks in typical quantities and sizes. This method kills two birds with one stone: high speed stamping, and high-quality bonding. To eliminate the downside of handling separate sheets, a fully automated system collects sheets below the progressive die and brings them to the gluing stations in a controlled and secure manner. These gluing stations are freestanding units that offer full control over all process parameters such as pressure, temperature and time. The solution is usually offered as a turnkey system that covers everything from winding off the raw material to the finished laminate stacks. That said, retrofits for existing machines are also available. **PTE**

schulergroup.com

Hannover Messe Focuses on the Industry of Tomorrow

Matthew Jaster, Senior Editor

Hannover Messe 2022 focused on industrial transformation, driven by the digitalization of industry and the reduction of CO₂ emissions.

Topics at this year's event included data analytics, the Internet of Things, artificial intelligence and IT security. Companies like Voith, NORD, Beckhoff and others presented the latest products and technologies during the event.

Voith Highlights Speed Pump Drives

Voith Turbo offered its compact, variable speed pump drives DrivAx IQ4 and DrivAx RQ4 during Hannover Messe 2022. The new drives extend the broad portfolio of the DrivAx product family. Other highlights included the self-contained servo drive DrivAx CLDP, whose ten-year success story is set to continue in new sizes, and the DrivAx CLCP, which was specially developed for robotics applications and can be seen live in action at the Voith Turbo stand.



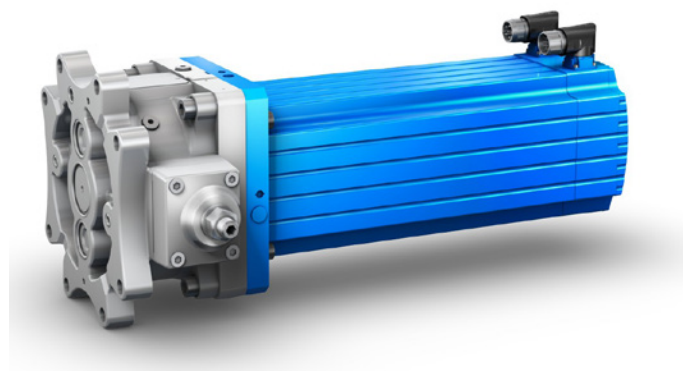
DrivAx IQ4 drives consist of a servomotor with a directly mounted internal gear pump that jointly control volumetric flow and pressure. The system allows for a maximum volumetric flow of 125 l/min and a maximum pressure of 270 bar. The speed-controlled pump drive DrivAx IQ4 combines energy efficiency with high power density and robustness. Unlike conventional, valve-controlled hydraulic systems, the DrivAx IQ4 offers power on demand. Thanks to this power-on-demand principle, the system can operate energy-efficiently at lower speeds in the part-load range and outside the machine cycle. The compact design and interface architecture allow easy integration into machine and control system.

The DrivAx RQ4 consists of a servomotor and directly mounted radial piston pump that together regulate a volumetric flow of maximum 450 l/min at a maximum pressure of 350 bar. The speed-controlled pump drive combines energy efficiency with high power density and robustness. In addition, unlike conventional valve-controlled hydraulic systems, the DrivAx RQ4 offers power on demand. This means that the system works efficiently at lower speeds in

the part-load range and outside the machine cycle. This power-on-demand principle in combination with the load-dependent switchable pump allows special load profiles with reduced-size motor and peripherals to be realized. The compact design and interface architecture allow easy integration into machine and control system.

The main components of the CLDP linear servo drive are a servo motor, an internal gear pump and an actuator. Pressure and/or position sensors ensure the precise control of force and position, while the speed and directional control of movement are affected without valve technology. Thanks to this design principle, there is no need for a hydraulic unit or piping. The compact design and interface architecture allow easy integration into machine and control system.

The DrivAx CLDP also offers an alternative to electromechanical drives. The technology combines the robustness and power density of hydraulics with the controllability of servo technology. Other benefits are the almost wear-free operation, resistance to force peaks, lower energy requirement and the elimination of cooling and lubricating units.



The DrivAx CLCP servo drive is a self-contained linear drive with an outstanding power-to-weight ratio. This also makes the linear drive an ideal alternative for robot-assisted applications. The main components of the DrivAx CLCP are a servo motor, a 4Q internal gear pump and an actuator. Pressure and/or position sensors ensure the precise control of force and position, while the speed and directional control of movement are affected without valve technology. This design principle means that there is no need for a hydraulic unit or piping. The load-adaptive or electro-hydraulic gear shifting reduces the size of the components and thus lowers procurement and installation costs. The compact design and interface architectures allow easy integration into machine and control system.

Thanks to these characteristics, the self-contained DrivAx

CLCP linear drive also offers an alternative to electromechanical drives, as the technology combines the robustness and power density of hydraulics with the controllability of servo technology. Other benefits are the almost wear-free operation, resistance to force peaks, lower energy requirement and the elimination of cooling and lubricating units.

voith.com

CompActive GmbH Introduces Thermally Controlled Bending Actuator


Ever since the issue of air resistance began to play a serious role in automotive engineering, experts have been working on concepts to minimize air vortices at fast-moving wheels. After all, these vortices are responsible for a not inconsiderable increase in overall air resistance and thus for greater energy consumption.

The wheels of electric vehicles that are particularly trimmed for efficiency therefore often feature closed rim designs with at most smaller openings, as these help to



reduce air resistance in the single-digit percentage range. More would be possible, but only closing the rim completely could more effectively stop the flow of air and the damaging rotor effect of the wheel. This, in turn, is in direct conflict with the necessary cooling of the brake chamber, especially in cases of higher loads, for example when descending a pass.

CompActive GmbH — based in Neustadt an der Weinstraße — addressed this challenge during Hannover Messe. With the



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help of bending actuators developed in-house, a particular specialty of CompActive, the company has succeeded in integrating several ventilation flaps into a rim. These open automatically due to the waste heat from the braking system, thus introducing the necessary cooling through the wheel surface when required. Since this solution does not require an external energy source, it can also be easily applied to the rotating components. According to CompActive, the flat bending actuators not only offer sufficient travel, but they are also said to have the necessary robustness to withstand the rough and tumble of everyday road traffic.

compactive.de/language/en/

Beckhoff Automation Offers Electric Cylinders for Linear Applications

The AA3000 series electric cylinders are the ideal direct drive for linear applications with high process forces and speeds. The advantages in terms of power, dynamics and compactness meet the advantages of servo technology, such as controlled positioning, safe holding at a standstill and high efficiency. The integrated mechanics of precise rolling bearings, ball screw and guide ensure a backlash-free, purely translational movement.



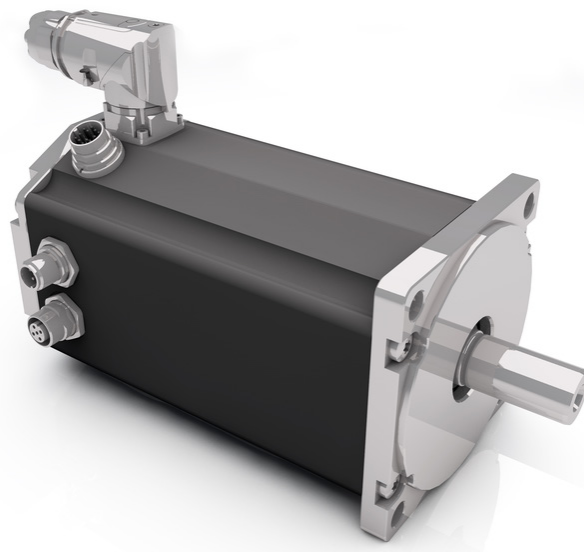
At the end of the shaft of the spindle is an external thread, on which commercially available adapters such as e.B. Ball heads or clamping hooks from the pneumatic/hydraulic range can be mounted. The flange dimension of the electric cylinder is based on ISO 15552 and has screw-on points on both sides if an application requires e.B. a swivel eye connection. This compatibility makes the switch from pneumatics to electric drive technology particularly easy.

The built-in, safe 24-bit multiturn encoder offers, in addition to the high resolution, the advantages of OCT and electronic nameplate for quick and easy commissioning with the well-known Drive Manager. A different spindle pitch or a backlash-free holding brake are available as options.

beckhoff.com

Dunkermotoren Expands Product Portfolio and IIoT Options

Dunkermotoren highlighted the company's holistic solution portfolio covering all aspects of the use and connectivity of its smart motors. Holistic means, on the one hand, from the initial consultation and joint concept development to project implementation in partnership. On the other hand, holistic also means from the field level to the cloud from a



single source, i.e., from the implementation of the control logic with MotionCode to condition monitoring and predictive maintenance using cloud services.

With nexofox, the drive technology manufacturer is breaking new ground and moving from a pure product supplier to a full-service provider. With nexofox, Dunkermotoren is launching its own brand, which fully addresses the topic of the Industrial Internet of Things and its unlimited possibilities as well as the connectivity and programmability of smart motors. In the field of integrated smart BLDC motors, Dunkermotoren has been considered a pioneer in the industry for years and is now once again taking on a pioneering role with nexofox.

With the new BG 95x120 dPro, Dunkermotoren expands the product portfolio in the BG 95 series by a new length and thus breaks its own records. The BG 95x120 dPro is currently the most powerful motor and achieves a peak power of 4.4 kW and a torque in the range of 14.5 Nm — with a battery voltage of just 48 VDC. These characteristics, combined with the space-saving slim design makes it the perfect drive for mobile applications including automated guided vehicles (AGVs) or autonomous mobile robots (AMRs) as an example. The transportation of heavy loads is no longer a problem.

As dPro version, the connection is very easy: No matter whether with CANopen or the Ethernet interfaces PROFINET, EtherCAT or Ethernet/IP. The BG 95x120 dPro can be integrated into the existing system and then be programmed and controlled via Drive Assistant 5 and/or MotionCode.

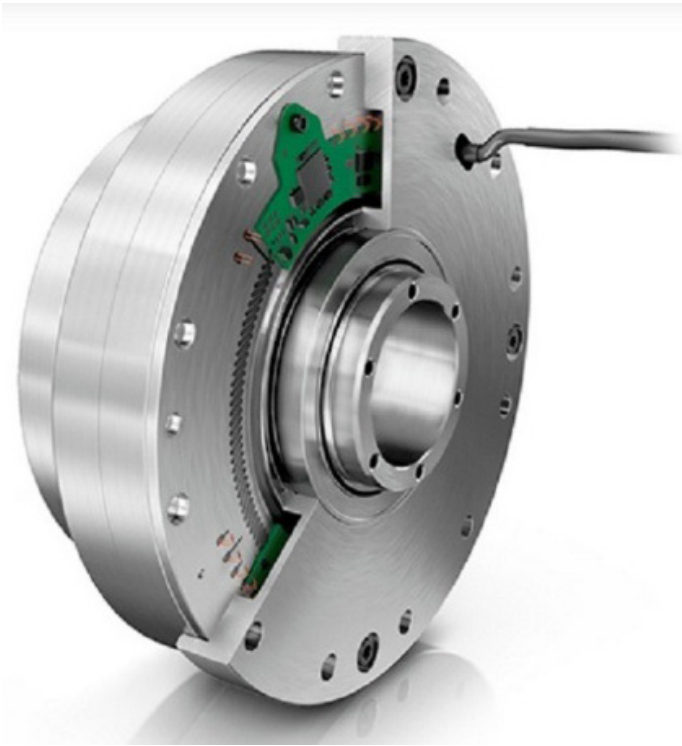
For more safety, the certified safe torque off (STO) function is available as standard for all BG 95x120 dPro. STO allows the motor to be switched off reliably and without torque. A sudden obstacle in the path of an AGV/ AMR is no danger anymore. Additionally, the logic voltage is not interrupted in such cases. This saves time-consuming re-referencing after restarting.

The BG 95x120 dPro is the perfect friend for more flexibility in transport robotics.

dunkermotoren.com

Schaeffler Focuses on Torque Sensor System

Whether direct drives, precision planetary gearboxes, angular contact needle roller bearings or UPRS motors — Schaeffler's exhibits were all innovation turned metal. The company premiered a fully integrated torque sensor system during the show. This solution, which is unique on the market to date, provides highly accurate torque signals without requiring additional installation space and without any loss of rigidity in the overall mechanical system.

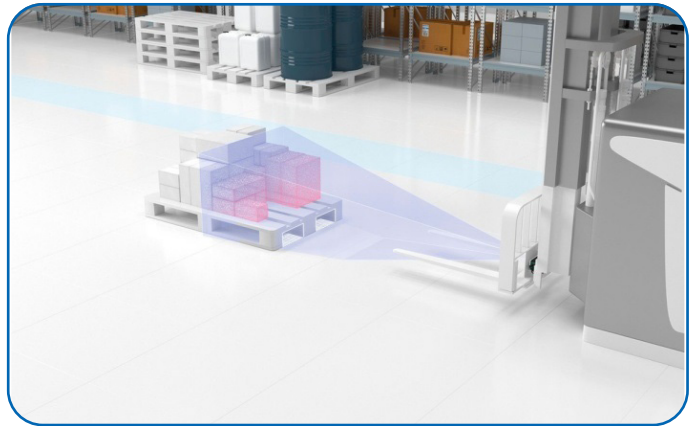


Today, production focuses on precision components and systems for powertrains and chassis as well as rolling and plain bearing solutions. With around 83,000 employees, one of the world's largest family-owned companies generated sales of around 13.9 billion euros in 2021. And with more than 1,800 patent applications, the Schaeffler Group ranked third among Germany's most innovative companies in 2021, according to the DPMA.

schaeffler.com

Pepperl+Fuchs Offers New Sensor Series

The new sensor series SmartRunner Explorer 3-D from Pepperl+Fuchs supplies the 3D vision data for controlling different applications.



It includes two device variants with their own measurement methods on one platform: Stereo Vision and Time-of-Flight. Housed in the same housing, with uniform user software and data output, the integration effort for 3D applications can be significantly reduced.

The stereo vision device has a range of one meter and a resolution of 1.4 megapixels. The size of the detection area is 400 x 350 mm at 600 mm and 550 x 500 mm at a distance of 900 mm. With these parameters, it is optimized for the high-precision detection of objects in this close range and is particularly suitable for inspection applications. For example, it can be used for checking and counting of defined objects or for volume acquisition. The additional depth information in the z-direction opens completely new application possibilities that remain closed with conventional sensors.

The device works with two cameras. Using the high-resolution 2D data, the sensor can be precisely aligned with the target object, which makes it easier to interpret the measurement results. In the first step, your 2D images are automatically superimposed to form a disparity image, which forms the basis of the 3D point cloud. It should also be mentioned that all devices are factory calibrated. **PTE**

pepperl-fuchs.com

Putting the Brakes on Supply Chain Issues and More

Braking solutions from Warner Electric, Force Control, and Miki Pulley

Aaron Fagan, Senior Editor

The complexity of supply chain issues in a globally interdependent economy is vast, and there are multiple aspects to be addressed in each problem. Food supply has been in the spotlight throughout the pandemic and considering inflation and other factors, the issues aren't likely to disappear overnight. However, companies like Warner Electric, Force Control, and Miki Pulley are literally putting the brakes on some of these issues with solutions for today and tomorrow. Warner Electric and Miki Pulley both offer brake solutions that include various robotic and battery-powered agricultural equipment being developed for the future while Force Control addresses the here and now with a brake solution for a palletizer problem that was disrupting production at National Frozen Foods.

Warner Electric Braking Technologies Help Battery-Powered Equipment OEMs

The rapidly growing demand for compact, battery-powered construction and agriculture equipment has created a highly competitive market environment for vehicle OEMs. Warner Electric, a global leader in electromagnetic brake technologies, supports equipment design engineers as they meet these application challenges.



Warner Electric's braking solutions are designed to reduce power consumption on a wide variety of motions for battery-powered construction and agriculture equipment, including autonomous machines.

Warner Electric has created braking solutions designed to reduce power consumption on a wide variety of motions for battery-powered construction equipment, including electric swing drives and electric track drives for loaders, dozers, and excavators, traction wheel motors on compact track loaders,

skid steers, wheeled excavators, dump vehicles and mobile elevating work platforms (MEWPs). Their braking technologies are also well suited for many other types of electric equipment, including agriculture autonomous machines, livestock feeders and sprayers, as well as firefighting and surveillance robots, shuttle buses, and road sweepers.

Warner Electric's application engineers routinely work with OEM engineering teams to develop compact, energy-efficient braking solutions to meet the requirements for specific applications, whether it's for a completely new equipment design or the electric conversion of existing equipment. "Utilizing existing, proven braking solutions, including the popular PK and CBTB ranges, Warner Electric engineers can quickly modify a standard brake design and ship prototypes to OEMs for testing," said Mourade Vaneekhoute, global mobile power equipment market director, Altra Motion. "Our ability to rapidly respond to a customer need saves valuable time and effort for busy OEM engineers while allowing them to focus on other critical vehicle systems and components."

Adopted by more than 30 key OEMs since 2010, Warner Electric's PK brakes are installed on more than 500,000 aerial work platforms and forklift trucks in the field. According to Vaneekhoute, "The benefits of this cost-competitive range include a one-piece design for easy assembly, lower power



The PK (Very Thin) range is a pre-assembled on/off dry spring-applied electromagnetic brake used for parking and emergency as well as some service braking.

consumption, longer battery life, and overall lower maintenance costs.”

The PK (Very Thin) range is a pre-assembled on/off dry failsafe electromagnetic brake. This failsafe brake is used for parking and emergency as well as some service braking. The vehicle’s AC motor is used in combination with the PK brake for regenerative braking of the vehicle. In addition to the standard friction material, PK brakes can also be fitted with high-torque and high-energy materials depending on the application. The coil can be designed for single- or dual-voltage and pulse-width modulation power supply to reduce power consumption and maintenance.

Low-profile PK captive design brakes are particularly suitable for back-to-back dual drive configurations such as MEWPs and telehandlers. These units are enclosed to withstand harsh outdoor environments. IP67-Rated models are available to meet challenging washdown application requirements.

The CBTB family of electromagnetic axle brakes are specifically for use on battery-powered, dual-drive vehicles with

capacities generally up to 8 tons (17,900 lbs.). These advanced high-speed, high-torque brakes provide reliable emergency and parking brake functionality and allow for increased maximum vehicle speed and improved productivity.

The integration of proprietary nonstick friction material within the brake design ensures very high energy dissipation and low wear throughout the life of the equipment. The CBTB is designed for vehicles that require the narrowest footprint. It is installed between both wheel motors on the load-bearing axle. When engaged, its double-disc arrangement allows the brake to act on both motors simultaneously.

An optional dual-stage functionality is available to provide better control of the torque by applying 50% or 100% of the brake torque capacity. It also prevents flat surface damage to tires that often occurs when wheels lock up during an abrupt emergency stop.

New proprietary W134 non-stick friction material has been designed by Warner Electric engineers to equip the Warner Electric spring-applied brakes for high-capacity braking requirements. Previously, the standard material was able to handle 57 kJ at 900 RPM, however, the new W134 material handles up to 190 kJ at 1,300 RPM. Vaneckhoute explained, “This new dry friction material enables implementation of electromagnetic brakes versus hydraulically actuated and wet brake technologies, removing the risk of oil leaks.”

warnerelectric.com

Force Control Ensures No Production Freezes for National Frozen Foods

Production stoppages at National Frozen Foods due to palletizer maintenance and repairs had company leaders concerned. The company packages high-quality frozen vegetables, like corn, green beans, peas, carrots, and more, into retail and foodservice containers. Just before they are shipped out, the packages, in sizes from 16 oz. to 5 lb. for retail customers, or from 10 kg to 55 lb. on the foodservice size, are placed onto pallets using palletizers. Running 18-hours a day for a minimum of 100 cycles per hour, the palletizers are a critical component. A motor and its brake engage each cycle to properly position the products on the pallets. But all shipping activity comes to a screeching halt when one of the motor brakes fail. When the production downtime began to cut into profits, Dan Snider, National Frozen Foods maintenance manager, looked for a solution that would keep production humming without breaking the budget.

“We were getting a lot of brake failures on the original



The CBTB family of electromagnetic axle brakes is specifically for use on battery-powered, dual-drive vehicles with capacities generally up to 8 tons.



When the production downtime began to cut into profits, National Frozen Foods looked to Force Control for a braking solution that would keep production humming without breaking the budget.

motors,” says Snider. “The original motors come with motor brakes included, which is just an electric brake on the back of the motors.” Every time the brakes failed, production would halt until the brakes were fixed or production was routed to another palletizer. As brake failures piled up, so did the plant downtime. At an hour plus for each breakdown, Snider soon noticed a substantial loss of production time,

“It takes at least an hour to switch to a different line and get production up and running again. It was easier to just fix the machine than to change the lines,” comments Snider. “When the brake motors need to be switched, it usually takes two to three hours.” With a production rate of six cases per palletizer cycle, a few hours of production time can lead to thousands of cases of product lost to downtime. This costly downtime along with the repair costs added up quickly.

“The cost of a brand-new brake motor was \$800, but a new brake cost \$500. It was three-quarters of the cost just to put

a new brake on a used motor. The cost savings wasn’t there, so we just kept buying new motors. I ended up with a lot of good motors sitting on the shelf with no brakes. We wanted something independent.” Snider found his solution with Force Control.

Six years ago, Snider began by placing Force Control X-Class Posistop brakes, specifically the XB2-3S3018SN-01, onto perfectly good motors that were sitting on shelves due to brake failures, then putting those back to good use on the palletizers. Since the replacement, the new brakes have performed exceptionally well. “We haven’t had a Force Control brake fail yet,” praised Snider. “We probably would have gone through three of the old brakes in the same amount of time. We actually have had zero downtime since we have changed over to these brakes.”

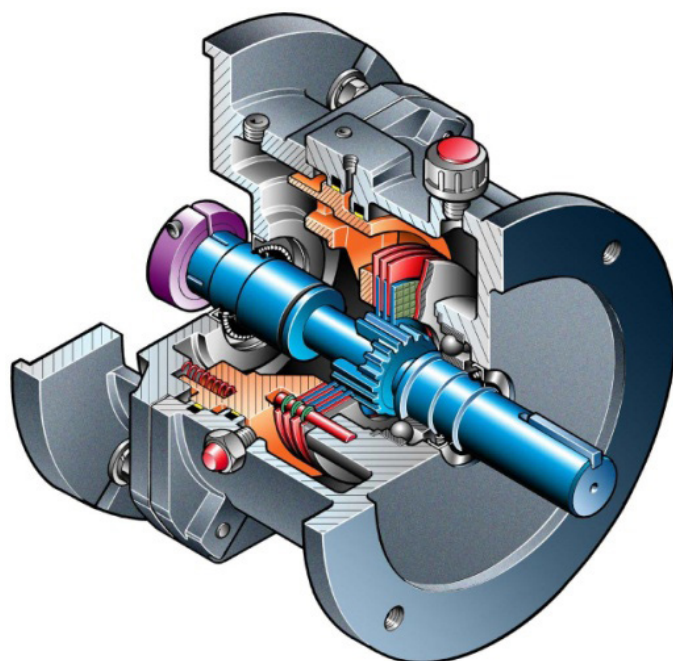
Force Control’s Posistop X-Class brakes work differently than the electric brakes initially put on the palletizer motors. Electric brakes use an electromagnet to apply friction between brake shoes and the brake drum that holds these components together. The brake shoes act as a sacrificial surface because the direct, dry friction causes wear and requires frequent maintenance and adjustment. The Posistop X-Class brakes use oil-shear technology to reduce maintenance and wear and thus extend the life of the brake.

Oil shear works by maintaining a film of transmission fluid between friction discs. When the brake is engaged, pressure is applied that puts the transmission fluid in shear and transfers the torque to the friction discs. This allows for a more cushioned stop, and dramatically reduces wear and maintenance. The transmission fluid is recycled through the system, dissipating any heat it absorbs during the process.

Snider also likes how easy it was to install the new brakes. “It was easy due to the fact the manufacturer of the original brake motors ran two wires to control the brake. We took the wire for motor control and wired a relay to deliver the same



The Posistop X-Class oil shear motor and coupler brakes are designed and tested to operate over 20 million trouble-free cycles.



A Clamped-Split-Quill shaft connection system stops play that could deform the key and keyway in high-torque, high-cycle applications.

signal that tells the motor to run to tell the brake to release,” says Snider. “We used the same wires that were already there. It was easy to do and works really well.”

The savings due to the new brakes were outstanding. “We’re at least two to one, maybe three to one in terms of cost savings,” rejoiced Snider. “And we only began this five years ago. That’s not long in terms of the life of a motor.” With these long-lasting brakes, the savings can continue for a long time.

With easy installation, zero failures, and significantly reduced downtime, Snider is very happy with the switch to the Posistop X-Class brakes. “They’re phenomenal,” claims Snider. “We’re saving cost-wise because we’re not buying motors, we’ve had zero brake failures and zero downtime since we switched. I don’t know why they didn’t use Force Control from the get-go.”

forcecontrol.com

Agricultural Autonomous Guided Vehicles Utilize Latest Miki Pulley Brakes

Autonomous Guided Vehicles (AGV) for agricultural applications are being developed at a record pace. The labor-saving potential of employing these vehicles is huge. These vehicles provide an opportunity for automating many agricultural functions including seeding, fertilizing, weeding, and harvesting operations.



Growers supplying plant-based fast foods see these AGVs as the future for the most efficient agricultural operation. As pictured, positive positioning control of the vehicle and the robot arm is achieved using the latest Miki Pulley BXH models.

An important key to the successful use of this AGV technology is efficient and positive positioning control of the AGV vehicle and its robotic arm. To achieve this control, the newest Miki Pulley BXH Brake model is specifically designed for the control needed in the agriculture environment. The crop conditions, terrain, and environmental conditions including weather factors such as temperature, moisture, humidity, and wind have a strong impact on AGV function.

AGVs are computer-controlled, wheel-based, and battery-powered. They are load carriers with robot arms that travel across fields and throughout greenhouses without an onboard operator or driver. Their movement is directed by a combination of software and sensor-based guidance systems. As a mobile robot, AGVs follow markers or wires in the field and greenhouse floor or use vision or lasers for guided movement. Because they are unattended and long-term operation is required, power for their uninterrupted operation is important. That is where Miki Pulley’s BXH brakes excel in these AGV applications.

The AGV must have emergency braking capability as well as a default brake to hold position when not in motion. The Miki Pulley BXH brake is a power-off engaged brake that will hold the AGV in place for predetermined periods while the robot arm, also controlled by a second BXH brake, performs planting, fertilizing, harvesting, and loading operations.

When the AGV must navigate a field or greenhouse, for example, the brake is energized which disengages the rotor disc and allows free rotation of the AGV drive wheels. The BXH Brake controls the robot arm in a similar manner. The BXH brake uses 24 VDC for a split second to overcome compression spring inertia to open the brake, then consumes only 7 VDC by utilizing the BEM power control module. This saves battery power and minimizes the number of battery recharging operations needed to keep the AGV system in continuous operation. **PTE**

mikipulley-us.com

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brakes

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To the Moon and Beyond with Additive Manufacturing

Aerojet Rocketdyne uses metal 3D printing technology from Velo3D to make a critical flight component lighter, smaller, and much less expensive than its predecessors

Velo3D

On the afternoon of December 19, 1972, Apollo 17's command and service module CSM-114 "America" splashed down in the Pacific Ocean, bringing its crew and cargo safely home. The event marked the end of NASA's eleven-year lunar program and humankind's final visit to the Moon. Thanks in part to Los Angeles, Calif.-based Aerojet Rocketdyne—a manufacturer with a proud heritage in spaceflight and rocket propulsion—we'll be going back soon, this time to stay.

Meet Apollo's Sister

In Greek mythology, Apollo was one of the twelve Olympians, gods of the sea, sun, and sky. It's therefore only fitting that NASA has named its next lunar expedition after the deity's twin sister and goddess of the Moon, Artemis. And while those many Apollo missions were hugely successful and crucial to the continuation of the United States space program, Artemis' goals are much more ambitious.

Beginning in 2022, NASA will place unmanned Orion spacecraft into lunar orbit, followed by crewed landings, construction of lunar habitats and supporting infrastructure, and ultimately, preparation for a visit to Mars. According to NASA administrator Jim Bridenstine, the space agency and its partners will accomplish this by the end of this decade and do so with half the buying power it had back in 1964, when Apollo development was at its peak.

One of the technologies that enables such ambitious plans? Additive manufacturing (AM), better known as



Even the first 3D-printed version of the revamped R-4D reaction control system was a huge improvement over its predecessor. AM technology from Velo3D made it even better.

3D printing. "As with any complex endeavor, the more affordable you can make it, the greater the chance that you will ensure its completion, and the moon is no different," said James Horton, aerospace engineer and mission architect at Aerojet Rocketdyne. "Metal AM plays a key role in achieving these goals."

Building on a Legacy

Aerojet Rocketdyne has a long history in metal AM. For more than two decades, the company has invested extensive time and resources into leveraging this important technology, focusing most of its energies on laser powder bed fusion (LPBF). It's due to these efforts that the aerospace manufacturer has been able to successfully design and integrate 3D-printed end-use components for a variety of projects, among them the massive RS-25 engines that will carry the Artemis mission into space.

Horton has been there for much of

it. Since 2008, he's held lead roles in rocket engine design, development, and test flight operations for NASA and the DOD. His advanced propulsion team at Aerojet Rocketdyne is currently working on chemical, electric, and nuclear propulsion to support NASA's deep space exploration efforts, the Artemis project included.

He'll tell you that metal AM, when used in conjunction with advanced design and simulation software, gives today's aerospace engineers "an entire buffet of solutions that were completely unavailable to their predecessors, providing the unparalleled ability to innovate without compromise." Because of this, Aerojet Rocketdyne has been able to drive down propulsion costs, speed up time to market, and improve the performance of its products like never before.

Case in Point

One recent example of this is a critical subsystem that Apollo engineers knew

as a “quad” reaction control system (RCS). The Apollo RCS included four individual R-4D bipropellant thrusters, originally designed by Marquardt Corp., that used hypergolic (spontaneously igniting) nitrogen tetroxide and hydrazine as propellants. Every lunar lander and service module had four quads, each of which generated more than 100 pounds of thrust to control the spacecraft’s roll, pitch, and yaw during flight. Following a series of acquisitions, Aerojet Rocketdyne

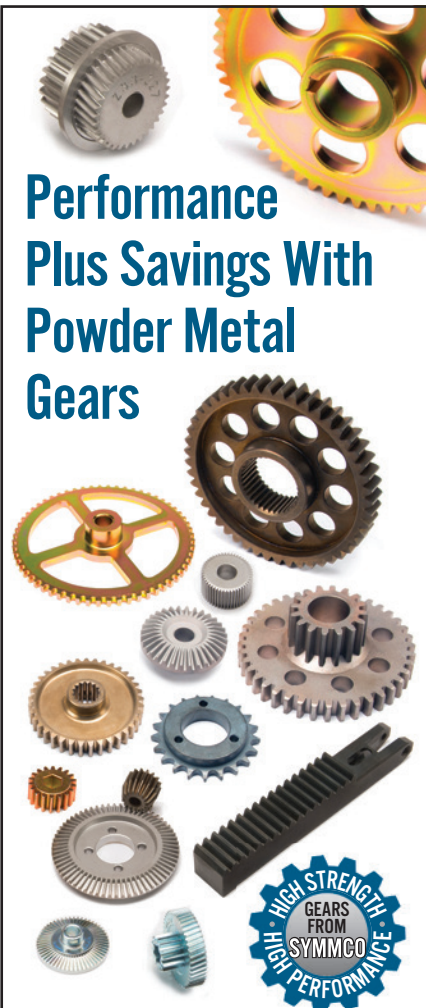
eventually took ownership of the R4-D, intending to use a modified version of the RCS on the future spacecraft.

Given that the original RCS design is more than 60 years old, Horton and his team recognized an improvement opportunity and began what would become one of the many internal research and development (IRAD) projects intended to optimize the systems required for the Artemis program and other commercial lunar projects. In the case of the RCS, they looked for ways



nTopology’s implicit modeling function was able to quickly “shell and fill” the injector body’s first design iteration, increasing its strength and printability while greatly reducing weight.

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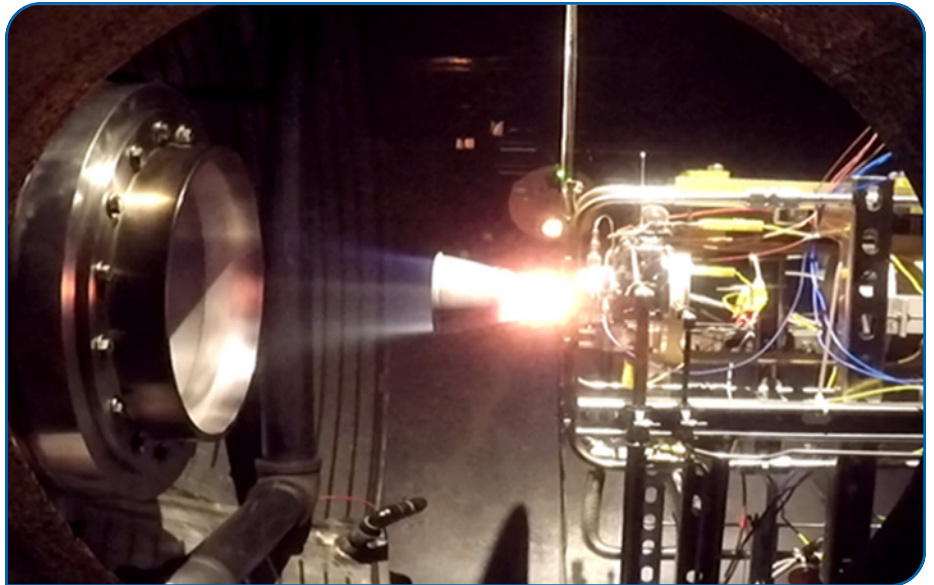
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to reduce the number of engine parts, increase its reliability, and make assembly and serviceability easier, all of which would decrease project costs while enhancing spacecraft performance. Metal AM checked all these boxes.

“During the entire Apollo program, NASA produced more than 650 thrusters to support six Moon landings,” said Horton. “It was a huge number, which led us to believe we were onto something big—we knew that, if we could bring affordability to the RCS, we could make a positive impact on any this and future programs.”

They also wanted to take advantage of rocket fuel advancements. As Horton explained, propulsion engineers had learned over the years that adding 25% nitric oxide to the fuel oxidizer mentioned previously—nitrogen tetroxide—would reduce its freezing point from -9°C (16°F) to -55°C (-67°F). Since this reduces the mass and power consumption of the heating systems needed to prevent frozen fuel lines in space, it presented Aerojet Rocketdyne with a significant opportunity. There was just one problem: the



The titanium thruster shown here was 3D-printed on Velo3D's Sapphire system. It is lighter, smaller, and more cost-effective to build than any other solution developed thus far.

MON-25 fuel just described is unstable, a condition that Horton suggested is a “bad thing to have in rocketry.”

Proving the Concept

Here again, metal AM was the answer, as it allowed the team to print special injector geometries that could burn

the fuel in a stable manner. They soon designed and built a concept model from the nickel-based superalloy Inconel 718, but unfortunately, ran into limitations with their metal 3D printer.

“We had to build the RCS injector body at a 45-degree angle, due to overhang concerns, and also add in a series of large support structures to prevent thermal warping during the build process,” Horton said. “The supports would need to be machined away afterward, adding cost to the product, while the orientation angle created less than desirable surface quality. There was definitely room for improvement.”

At the same time, they realized there was room for substantial lightweighting and topology optimization. Horton noted that they’d eliminated “large chunks” of unnecessary material during the redesign, but it was far from perfect. “Every single pound of material you can remove from a spacecraft saves money on launch costs,” he said. “That’s why we turned to nTopology for help with optimizing the design, and then Velo3D to build it for us.”

Shell, Fill, and Print Again

Technicians from New York-based engineering and design software company nTopology were quickly able to “shell out” the injector body’s blocky structure, leaving consistent wall thicknesses around the complex fluid ports and channels while eliminating stress



The final version of Aerojet Rocketdyne's “Mk. II” RCS injector block, shown in its as-built orientation.

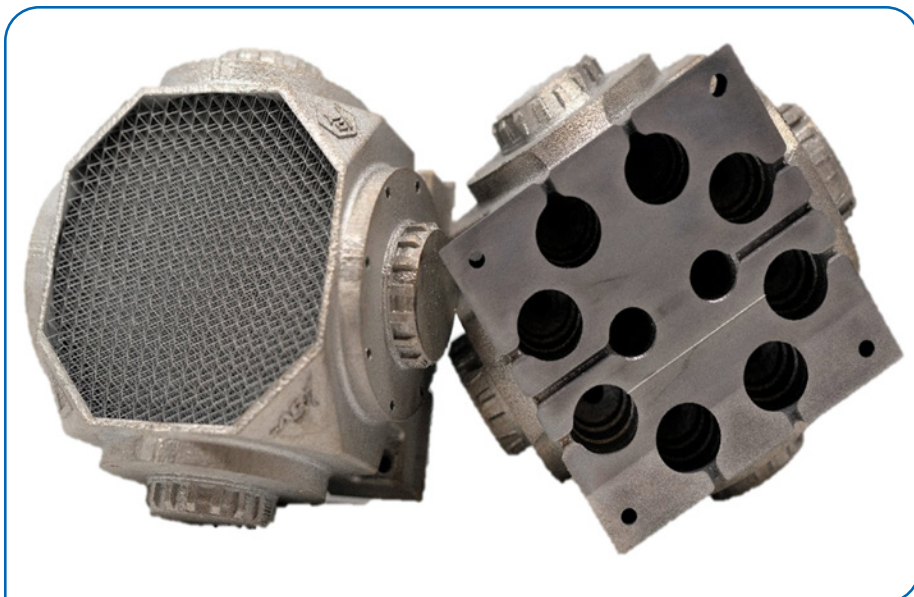
concentration areas. They then filled the resultant void with a thin lattice structure, increasing its strength and stiffness while adding only minimal weight; because of its “implicit modeling” capabilities, nTopology was able to cut the quad injector’s mass in half.

The Aerojet Rocketdyne team sent the optimized part file to Velo3D’s facility in Campbell, Calif. It was there that the metal AM solution provider gave Horton some good news. Due to the company’s mastery of 3D-printed titanium — a metal favored throughout the aerospace industry for its strength and light weight—the RCS injector body would weigh much less than its Inconel counterpart. And as Velo3D technical sales engineer Gene Miller noted, there’d be no need to build it at an angle or use the big, blocky supports as in the first iteration.

“Our proprietary, pre-print software is intuitive enough to recognize different geometric features and apply specific laser parameters to those areas so that they print as efficiently as possible and without the need for added support material,” Miller said. “In addition, we’re one of the few metal AM system providers that can successfully print large complex titanium parts without cracking. We have a unique solution to mitigate accumulated internal stress within the printed material, and can avoid cracking more so than other printers on the market.”

The final result? Aerojet Rocketdyne now has an RCS thruster that is 1/5 the mass, 1/2 the size, and 1/3 the cost of a conventionally manufactured version. And since it contains far fewer components, it’s also easier to assemble, with much less chance of failure during operation. Said Horton, “We’ve shown that by leveraging additive manufacturing and advanced software technology, we’re able to interject affordability, reduce lead times, and greatly improve upon system performance compared to the way we built parts in the past. Our next step is to demo this proof of concept, bringing it into actual field testing and, hopefully, final qualification. From there, it’s headed into space.” **PTE**

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Velo3D offers a unique solution to mitigate accumulated internal stress within the printed material to avoid cracking more than other printers.

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Using and Specifying Flexible Couplings

Prepared by members of the AGMA Flexible Coupling Committee

The technical division of AGMA directs the committees that develop and maintain standards and information sheets pertaining to the gear industry. Although often viewed as an accessory for gearboxes, flexible couplings are critical components of any machinery system, since they connect two separate pieces of rotating equipment. The Flexible Coupling Committee is responsible for 12 standards and one information sheet that are specific to flexible couplings. Six of those standards encompassing three subjects will be highlighted:

- “Flexible Couplings – Potential Unbalance Classification,” ANSI/AGMA 9000 and 9110 (metric edition)
- “Bores and Keyways for Flexible Couplings (Inch Series),” ANSI/AGMA 9002 (inch series) and 9112 (metric series)
- “Flexible Couplings – Keyless Fits,” ANSI/AGMA 9003 and 9103 (metric edition)

ANSI/AGMA 9002 & ANSI/AGMA 9112

While ANSI/AGMA 9002 and 9112 present all relevant information regarding bores and keyways, one topic is often subject to confusion: tolerances and resulting fits.

ANSI/AGMA 9112 is not only the transcribed metric series of ANSI/AGMA 9002, but it also incorporates and embraces the design principles, nomenclature and metric culture. Due to the metric design principles, there are a few key differences. To begin with, it utilizes the ISO 286 alphanumeric codes for tolerances (e.g., H7, m6). The keys and keyways defined in ANSI/AGMA 9112 are based on ISO R773:1969, and these metric-based keys/keyways are significantly different than those of ANSI/AGMA 9002. ANSI/AGMA 9112 includes transitional fits in addition to ANSI/AGMA 9002’s clearance and interference fits. Shaft tolerances are based on ISO R775:1969, and bore tolerances are recommended so that resulting shaft/bore fits are similar to ANSI/AGMA 9002. Due to the differences in design basis between inch-based and metric-based shaft and key systems, do not use the metric nomenclature for inch-based shaft and key systems; likewise, do not use inch nomenclature for metric-based shaft and key systems.

ANSI/AGMA 9003 & ANSI/AGMA 9103

ANSI/AGMA 9003 and 9103 present “information on design, dimensions, tolerances, inspection, mounting, removal and equipment that is in common use with keyless tapered and keyless straight (cylindrical) bore hubs for flexible couplings.” Keyless fits require a higher interference rate between the hub and shaft than those specified in ANSI/AGMA 9002/9112 for torque transmission. To determine

the necessary fits, ANSI/AGMA 9003/9103 provides calculations for pressures and allowable stresses for mounting, dismounting and operation, taking into consideration torques and operating conditions. Installation and removal of keyless hubs requires special consideration. Traditional methods of heating the hub for installation of interference fits can be used but require very high temperatures to ensure ample clearance. Often, mounting and removal of hubs requires hydraulic pumps to expand the hub, reducing or eliminating damage to the mating surfaces. Hydraulic mounting and dismounting uses significant pressures and generates extreme forces; therefore, caution must be taken as hubs, especially for tapered interfaces, can be propelled axially as the bore expands and releases from the shaft. Hydraulic pusher/puller assemblies are used to safeguard for this scenario.

ANSI/AGMA 9000 & ANSI/AGMA 9110

ANSI/AGMA 9000 and 9110 are the only standards that go into full detail on selection of balance classes and how to calculate both the potential and residual balance of a coupling component and/or assembly.

The typical user would be most interested in understanding the difference between potential unbalance and residual unbalance. Potential unbalance is defined as “the maximum amount of unbalance that may exist in a coupling assembly, whether corrected or uncorrected.” Essentially, it is a calculated value that is based on several factors, such as clearances in mating parts, allowable machining tolerances and runouts, balance tooling runouts, etc. Residual unbalance is defined as “the final amount of unbalance that remains in a coupling component or assembly after balancing, prior to removal from the balancing machine.”

The standard also defines various balance classes that are determined by the amount of potential unbalance or the residual unbalance. These balance classes offer users and OEMs a guide to choose what is required for an application. The OEM will dictate the “system sensitivity” to unbalance. Once the system sensitivity is understood, that is used in conjunction with the operating speed to determine the required balance class of the coupling. The coupling manufacturer will then state the level of balance required for that application.

The above six standards are one-half of the catalog of AGMA standards that are maintained by the Flexible Coupling Committee. As a set they provide a comprehensive understanding for using and specifying flexible couplings in industrial applications. **PTE**

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Schaeffler Group

ACQUIRES MELIOR MOTION GMBH

Schaeffler has signed an agreement to acquire all of the shares of Melior Motion GmbH. The acquisition of this supplier of precision gearboxes for robotics and other applications in automation expands the robotics portfolio of the Schaeffler Group's Industrial division. As automation of both simple, repetitive tasks as well as complex mounting and manufacturing processes is progressing rapidly, the Industrial division consistently expands its position as a supplier for robotics components and systems. In a first step, the division has brought a Strain-wave gearbox equipped with an electric motor and sensors for use in collaborative robots (cobots) to the point of volume production. In a second step, it is now adding more powerful gearboxes for higher payload capacities in industrial applications to its portfolio.

Over several years, Melior Motion GmbH has developed and successfully brought to the market an innovative planetary gearbox for industrial robots that is highly precise, features outstanding repeat accuracy, low noise emissions as well as very sound robustness. A modular platform concept has been developed based on this technology. The first gearboxes of this design have been on the market since 2017.

The company, which generated revenue of around 23 million euros in 2021, has over 100 employees and is located in Hameln, Germany. It is currently planning another production site in China. Europe and China are currently the main sales markets of Melior Motion GmbH. The company was established in 2017 and traces its origins back to the Stephan-Werke founded in 1908, which was acquired by Premium Ltd. in 2011.

"In Melior Motion GmbH, we are acquiring a highly innovative company in the robotics field that is on a strong growth course. This acquisition adds to our still young portfolio of robot actuators and considerably expands our position as an innovative supplier in this important business area. As a user of robots ourselves, we will also utilize the special characteristics of this portfolio to increase efficiency at our 75 Schaeffler production sites," said Stefan Spindler, Schaeffler's CEO Industrial.

Melior Motion GmbH and its predecessors have been developing precision gears for robotics manufacturers and applications in industrial automation for over 30 years. After many years of collaborating with Kuka, the new, innovative precision gearbox was qualified for two industrial robots as

well and is currently installed in two axes of the KR Cybertech and six axes of the KR Iontec. Melior Motion GmbH will considerably expand its production capacity in 2022.

Ralf Moseberg, senior vice president industrial automation at Schaeffler Industrial, states: "The developments and products of the highly qualified team at Melior Motion GmbH are an ideal addition to the Schaeffler Group's product portfolio. The much lower backlash, compared to competitors' products, is derived from an ultra-precise planetary gearbox concept with special characteristics. The high torque density, long service life, and outstanding energy efficiency are of exceeding interest to our large customer base in the field of robotics. The two companies' products are complementary and share the same group of customers. We also expect the similarity of our manufacturing technologies to enable us to realize synergies in purchasing and production."



Chris Morrell, managing director of Melior Motion GmbH, states: "We are delighted to gain a new owner and strategic partner for the future in the Schaeffler Group. Its global footprint, manufacturing expertise, and especially its ability to scale up the business will enable us to launch another phase of accelerated growth with respect to industrial robots and the machine tool market. Along with Germany, we especially plan to considerably increase local production capacity in China. This can now be done much more rapidly within Schaeffler's existing infrastructure."

schaeffler.com

Forest City Gear

ANNOUNCES APPOINTMENT OF NEW PRESIDENT, KIKA YOUNG

Forest City Gear is proud to announce the appointment of **Kika Young** as president of the company.

Young looks forward to building upon the legacy of her parents, Fred and Wendy Young. Wendy Young was president of the company from 2002 until 2012, when she was named CEO. She served as CEO until her passing in February of 2022. Wendy was instrumental in establishing Forest City Gear's reputation as a world-class, family-owned gear manufacturer.

Under Kika Young's leadership, the company's senior management team, which includes Jared Lyford, director of manufacturing operations; Jeff Mains, director of technical operations; and Gary Strakeljahn, controller, will continue to drive Forest City Gear's commitment to excellence without exception, to delivering to the high standards of quality and service that the company is known for throughout the industry.

According to Fred Young, chairman of Forest City Gear, "To say it's been a difficult year is an understatement. At the same time, we are so thankful for the support we've received. It has been invaluable in helping us to make a plan as a family and for the company. Ultimately, we all agreed that the best way to honor Wendy's legacy and the legacy that every member of the Forest City Gear family has helped build, is by continuing to operate as a family-owned company. I look forward to watching Kika as president, with the support of her sisters Appy Mikel and Mindy Young, lead the company into the future, while continuing to honor the traditions that make Forest City Gear such a special place."

forestcitygear.com



Solve was established in 2020 to serve as a one-stop resource for both metric and American standard power transmission products through its platform of brands including P.T. International, IPTCI Bearings, and LMS Bearings. Solve continues to grow this portfolio with its second acquisition in three months, having acquired Bearings Limited, which manufactures the Tritan brand, in December 2021. Based in Charlotte, North Carolina, Solve currently operates 11 facilities across the United States.



SST Bearings adds to Solve's presence across multiple verticals, including food and beverage, material handling equipment, agriculture, automotive manufacturing, textiles, mining, and pharmaceuticals.

solveindustrial.com

Siemens Digital and Sierra Space

COLLABORATE ON DIGITAL ENGINEERING PROGRAM

Siemens Digital Industries Software recently announced that Sierra Space has implemented *Siemens Xcelerator* software and service portfolio as the foundation for its next-generation digital engineering program. Sierra Space is a commercial space company helping to shape the future of space transportation and infrastructure for the commercialization of low Earth orbit (LEO).

The company is implementing *Xcelerator* to create a fully digital environment from development to manufacturing to maintenance. This will help to achieve the goals: Sierra Space wants to develop future solutions for space transport, as well as commercial space travel and infrastructure, and create technologies on which a vibrant, growing and accessible commercial space industry will be built.

"At Sierra Space, we are building the first platform in space that brings together all aspects of space transportation, space targets and space applications in a holistic ecosystem. It will be a catalyst for the next breakthrough innovations that will also bring many benefits to life on Earth. Our revolutionary new space platform is being developed using a next-generation digital development environment that we created in collaboration with Siemens," said Tom Vice, CEO of Sierra

Solve Industrial

ACQUIRES SST BEARING CORPORATION

Solve Industrial Motion Group has acquired SST Bearing Corporation ("SST Bearings"), a worldwide supplier and manufacturer of bearings and power transmission components.

The acquisition of SST Bearings further enhances Solve's portfolio of bearings and power transmission offerings, expands its portfolio of product offerings, and strengthens its supply chain to better serve its customers, particularly original equipment manufacturers.

Headquartered in Loveland, Ohio, SST Bearings was founded in 1957, and offers a wide selection of radial bearings, mounted ball bearings and inserts, power transmission products, castings, and custom assemblies. The acquisition also includes USA Rollers, Inc., a conveyor components company.

Space. “Siemens’ solutions will significantly accelerate the development of our unique space platform.”

Siemens’ tools were fundamental to the development of the Dream Chaser. Sierra Space is building on this long-standing collaboration with Siemens to fully transform itself into a digital company. Sierra Space will use *Siemens Xcelerator* at all stages of Dream Chaser’s development, including structural, thermal, mechanical, electrical and software design, vehicle manufacturing, requirements review and lifecycle maintenance.



The spacecraft is capable of performing a smooth 1.5 g re-entry when transporting crew and cargo and landing on compatible commercial runways worldwide. As a representative of the next generation of space transport, NASA has commissioned the Dream Chaser to carry out cargo delivery and return missions to the International Space Station (ISS). The spacecraft transports up to 5.4 tons per flight. Sierra Space continues to expand this long-standing collaboration with Siemens as the company transforms into a digital enterprise.

In parallel with Dream Chaser, Sierra Space is working to design, develop, build, operate and support a customer-centric goal in Earth orbit. In collaboration with Blue Origin, Sierra Space has developed the large integrated flexible environment (LIFE)-Habitat, a key component of the Orbital Reef project. This modular, three-story commercial residential and science platform will provide the opportunity for companies from the manufacturing, pharmaceutical and other industries to take advantage of weightlessness. It can be used in low-Earth orbit, on the lunar surface, in lunar orbit and as a transport vehicle to Mars. Sierra Space will use *Siemens Xcelerator* in all phases of LIFE-Habitat development and other space target missions.

“We are honored to be working with Sierra Space on their mission to democratize access to space. We look forward to supporting the Sierra Space team in advancing the Dream Chaser product line and LIFE-Habitat with the world’s most comprehensive digital twin technology at the heart of their technology strategy,” said Tony Hemmelgarn, CEO and chairman, Siemens Digital Industries Software. “This is another in a long list of announcements that show that today’s pioneers are using *Siemens Xcelerator* as a platform for real innovation.”

sw.siemens.com

Sulzer

EXPANDS SERVICE CENTER

Sulzer has begun the construction of an all-new 7,200 sq. ft. expansion to its Baton Rouge Service Center in Louisiana. Breaking ground in a ceremony on December 9, 2021, the project is designed to enhance repair, reengineering and upgrade services for operators of all types of rotating equipment in the US Gulf Coast area.

Glenn Doerksen, president, pump services NAM at Sulzer, said during the ceremony: “It’s really an exciting day for Sulzer and the Baton Rouge service center. This expansion has been made possible by our products, services, customer relationships and expertise. I’d like to thank everyone who has enabled this success - from here we grow and add to our history.”

Expanding its facilities at Baton Rouge is a key component of Sulzer’s ongoing investment strategy, growing its market-leading capabilities through enhanced service center capacity and equipment.

Once complete, Sulzer customers will benefit from even shorter lead times on all repair, reengineering and upgrade projects - especially for large vertical pumps and small steam turbines. Throughout the duration of the expansion, Sulzer’s usual high levels of service will continue to be available to customers.



The Baton Rouge Service Center is a service provider to the power generation, petrochemical, steel and heavy-manufacturing sectors as well as many others. A part of Sulzer’s global network of service centers, Baton Rouge offers a specialized range of 24/7 in-house and field engineering services, delivering projects on reduced lead times and to exacting standards.

The expansion will add to the 10,500 sq. ft. of floorspace currently available at the service center. New machines, an upgraded crane with a 20-ton lifting capacity, as well as a dedicated painting and a blast booth will also be installed as part of the project.

Beyond supporting Sulzer customers, the new service center expansion will provide increased job opportunities in the local area. Sulzer is looking to hire new mechanics, machinists, office staff, sales teams and apprentices, once construction work is complete.

sulzer.com



July 5–6–Bearing World by FVA

Bearing World, presented by FVA, (Wurzburg, Germany) focuses on the topic of bearings in theory and application. In technology, wherever there is movement, rolling element and plain bearings are essential. This is true for general mechanical engineering, the automotive industry and others. Bearings transmit operating forces between moving machine components, and therefore play a crucial role in the functionality, efficiency, and service life of the overall machine or system. The stresses on rolling bearings are very high, and will continue to increase in the future, as will expectations of reliability. Therefore, appropriate bearing selection and dimensioning as well as the optimal design of the bearing environment are indispensable. This requires constant growth in expertise based on practical experience and scientific knowledge. This includes, for example, bearing installation to ensure optimum clearance and preload, lubrication and sealing design, corrosion protection, condition monitoring, and targeted improvements based on extensive failure analysis.

bearingworld.org

July 19–21 –AGMA Gearbox Systems Design

This course (Clearwater, Fla.) focuses the supporting elements of a gearbox that allow gears and bearings to do their jobs most efficiently. Learn about seals, lubrication, lubricants, housings, breathers, and other details that go into designing gearbox systems. Raymond Drago and Steve Cymbala will instruct the course. Gear design engineers; management involved with the design and manufacture of gearing type components; metallurgists and materials engineers; laboratory technicians; quality assurance technicians; furnace design engineers; and equipment suppliers should attend.

agma.org/education/advanced-courses/2022-gearbox-systems-design/

July 25–28 –Reliable Plant 2022

This three-day event (Orlando, Fla.) offers attendees learning sessions and case studies on the latest industrial lubrication and oil analysis technologies. The comprehensive conference schedule covers every facet of the machinery lubrication industry and includes workshops on topics such as employee performance, lubrication fundamentals, condition-based maintenance and maintenance planning. Reliable Plant is focused on both entry level and manage-



ment positions within the lubrication industry including engineers, plant managers, maintenance professionals, safety personnel, planners, quality managers and more.

conference.reliableplant.com/

August 22–25 –Advanced Concepts of Bearing Technology Training

This course builds on the foundations of the essential course and challenges the experienced engineer in areas such as failure modes, friction & wear, fatigue life calculation methods and load distribution. This is an exceptional course for engineers with 2–3 years' work experience in bearings or past attendees of the Essential Concepts of Bearing Technology.

americanbearings.org/events/EventDetails.aspx?id=1564976



September 11–14 –Turbomachinery and Pump Symposium

TPS (Houston, Tex.) offers a forum for the exchange of ideas between rotating equipment engineers and technicians worldwide. Now surpassing 49 years, TPS is known for its impact on turbomachinery, pump, oil and gas, petrochemical, power, aerospace, chemical and water industries through an exhibition and a technical program. The TPS technical program is hand-selected by advisory committees. Topics cover maintenance, reliability, troubleshooting, instruction on emerging designs, technology, and best practices that include case studies with real-world relevance on problems solved and lessons learned.

tps.tamu.edu

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Electric Future/Industrial Past

Sloan Museum of Discovery Celebrates Automotive Manufacturing History

Matthew Jaster, Senior Editor

The history of the automotive industry began in “Vehicle City” thanks to the production of wagons and horse-drawn carriages in Flint, Mich. Companies like the Durant-Dort Carriage Company and Flint Wagon Works set the groundwork for the formation of General Motors in 1908. By the early 1980s, Flint was commonly referred to as “Buick City” and represented General Motors early attempts with the ‘Just-in-Time’ manufacturing concept. This slice of Americana will be on display at the renovated Sloan Museum of Discovery, reopening in July 2022, in Flint.



“The story of Buick and our automotive industry is a story of innovation,” says Todd Slisher, CEO/Executive Director at the Sloan Museum of Discovery. “So many new technologies were invented and perfected in Flint to advance the automobile. This spirit of innovation is still important today, driving our future advancements in electric cars, autonomous vehicles and many more changes.”

In addition, the story of the automobile is also tied to the history of organized labor. The Flint Sit Down Strike led to the first union contract between an automotive manufacturer (GM) and the UAW. This movement built the American middle class. This history is important to understand, as it can help inform museum visitors as to the future of manufacturing in Michigan and the United States. Slisher says that you can’t tell the history of Flint without a large part of it being about the automotive industry. As home to Buick, Chevrolet, and eventually General Motors, Flint’s main story IS the automobile industry and those businesses and people that were tied to it.

The automotive history of Flint will be a large part of the new History Gallery at Sloan. In addition, a new Vehicle City

Gallery will focus exclusively on the history and advancement of the automobile as showcased through the Sloan Museum vehicle collection as well as loaned vehicles, including a rotating GM concept car to talk about the future of the automobile.

In 2018, Sloan Museum started a major project of renovation and expansion. They launched a \$30 million fundraising campaign and broke ground for the massive renovation in June of 2019. The renovation and expansion of the new Sloan will nearly double the size of the main museum building from 58,000 square feet to 107,000 square feet. The new Sloan, named the Sloan Museum of Discovery, will feature early childhood learning, hands-on science exhibits, Flint and Genesee history, and a new vehicle gallery.

“We created focus groups to ask the community how they wanted the new Sloan Museum to evolve. One of the main themes we heard was that they wanted a more interactive, engaging museum. Therefore, although we still feature many artifacts, we also have interactive hands-on exhibits in every gallery,” Slisher said.

STEM education is infused throughout the new museum. An entire 11,000 square foot gallery, Discovery Hall, will feature science and hands-on STEM exhibits. “We also have a new Maker’s Lab, a space for making, tinkering, and creating items that solve challenges and will serve as our engineering hub. In addition, programs in our three new Learning Labs will focus on STEM and social studies topics,” he added.



Gearheads, history buffs and auto aficionados will be right at home when the museum reopens this summer. **PTE**

sloanlongway.org/discoverloan



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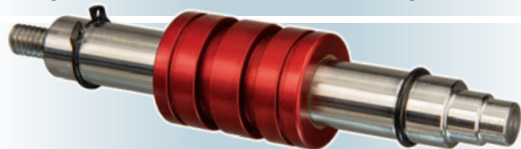
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